

REMARKS

In response to the Office Action dated November 5, 2004, Applicants respectfully request reconsideration. To further the prosecution of the present application, each of the rejections has been carefully considered and is addressed below. The claims as pending are believed to be in condition for allowance.

It should be appreciated that Claims 1, 14, and 24 have been amended solely for clarification purposes and not to overcome the rejections presented by the Office Action.

Overview of Embodiments of the Invention

One embodiment of the invention is directed to a method and apparatus for mirroring and restoring data (specification, page 1, line 5). The copying of data in real time from one storage area to another is referred to as mirroring data (page 2, lines 6-7). A mirror is created by synchronizing it to a source or standard storage area, so that updates to the standard storage area are also performed to the mirror (page 2, lines 21-24). A mirror that is synchronized to the standard storage area is said to be in a mirrored state, whereas a mirror that is no longer synchronized is said to be in a split state (page 2, lines 24-26). A mirrored storage area in a split state can be considered a snap shot of the standard storage area at a particular point in time (page 3, lines 1-5).

If a standard storage area becomes corrupted, the data may be restored from a mirror in a split state (page 8, lines 4-6). In conventional systems, a restore operation that restores data to the standard storage area from the mirror typically involves not only copying information from the mirror to the standard storage area, but also a resynchronization so that any updates to the standard storage area are passed to the mirror (page 8, lines 6-9). However, Applicants appreciate that if a corrupting write were made, the corrupting write would be performed to the mirror as well as the standard storage area, so that the ability to recover uncorrupted data may be lost (page 8, lines 10-12).

In accordance with the one embodiment of the invention, while a restore operation is performed from a mirror to a standard storage area, updates to the standard storage area are not passed to the mirror, so that the integrity of the mirror is retained (page 8, lines 13-15).

The foregoing summary is provided merely to assist the Examiner in appreciating various aspects of applications for embodiments of the present invention. However, all of the discussion above may not apply to each of the independent claims, and the language of the independent claims may differ in material respects from the discussion provided above. Thus, the Examiner is respectfully requested to give careful consideration to the language of each of the independent claims and to address each on its own merits, without relying on the summary provided above. In this respect, Applicants do not rely on the summary provided above to distinguish any of the claims of the present application over the prior art, but rather, rely only upon the arguments presented below relating to each specific independent claim.

Rejections Under 35 U.S.C. §102

Claims 1-36 are rejected under 35 U.S.C. §102(e) as allegedly being anticipated by U.S. Patent No. 6,047,294 ("Deshayes"). This rejection is respectfully traversed.

Deshayes is Commonly Assigned and Shares Common Inventors

Deshayes and the present application are both assigned to EMC Corp., although this may have escaped the Examiner's notice given the fact that the assignee is not listed on the front of Deshayes. The assignment for Deshayes is recorded at Reel 9086 Frame 0717, illustrating the common assignment. In addition, the two named inventors of the Deshayes' patent are among the four listed inventors of the present application.

Deshayes

Deshayes discloses a method of backing up and restoring data in a computer system (col. 5, lines 49-51). In various embodiments, a direct connection is established between a storage system and a backup storage system (col. 7, lines 27-30), and one embodiment is directed to a method of performing a backup using the system (col. 9, lines 21-23). The method begins with a discovery process, where software identifies the physical storage segments that are required to be backed up (col. 9, lines 23-27). A backup preparation phase is performed, during which the storage system is placed into a state permitting a backup to be performed (col. 9, lines 33-38). A backup execution phase process is then performed using the direct connection between the

storage system and backup storage system (col. 9, lines 39-47), followed by a backup cleanup phase which restores the storage system to its full operational condition (col. 9, lines 48-50).

Deshayes teaches that if a backup is to be performed off-line, any application accessing data on the storage system is taken off-line (col. 11, lines 39-40). An off-line backup does not allow an application to read or write any data into or from an area of memory that is to be backed up (col. 11, lines 32-36). Furthermore, if the off-line backup is being performed on a mirrored system, then the mirroring is broken (col. 11, lines 48-50). Breaking the mirrors severs the normal mirroring procedures (i.e., breaks the mirror links) in the storage system for at least one of the copies of the mirror. The mirrors are broken while the application is off-line to avoid the risk of data being written to some of the mirrors but not all while the mirrors are being broken (col. 11, lines 50-56). The application is then brought on-line, and is permitted to continue processing using a primary copy of the volumes, while the backup is performed using a mirror copy that has been taken out of the mirror redundancy group (col. 11, line 66 – col. 12, line 4). After the backup is performed, the mirrored volumes can be brought back into the mirror redundancy group by resynchronizing the mirror volumes that were taken off-line and restoring the mirror connections (col. 12, lines 5-10). Once the mirror connections are restored, the mirrors are once more in a linked state wherein any update to one mirror causes an update to each other mirror in the group (col. 3, lines 63-65).

Claims 1-13

Claim 1 is directed to a method for mirroring data of a first storage area. The method comprises: (A) placing a second storage area in a first state wherein updates to the first storage area are made to the second storage area, (B) mirroring data from the first storage area to the second storage area while the second storage area is in the first state, (C) changing a state of the second storage area from the first state to a second state in which updates to the first storage area are not made to the second storage area and (D) restoring data to the first storage area from the second storage area while maintaining the second storage area in the second state.

Deshayes simply does not teach or suggest mirroring data from a first storage area to a second storage area while the second storage area is in a first state (in which updates to the first storage area are made to the second storage area), and restoring data to the first storage area from

the second storage area while the second storage area is in a second state (in which updates to the first storage area are not made to the second storage area). Without conceding that Deshayes shows any other aspect or feature recited in claim 1, Applicants note that, even if interpreted in the manner set forth in the Office Action, Deshayes fails to disclose at least this aspect of claim 1.

The Office Action asserts that restoring data to a first storage area from a second storage area while the second storage area is in a second state (in which updates to the first storage area are not made to the second storage area) is taught by Deshayes in two places, namely col. 5, lines 49-61 and col. 13, lines 34-58. Applicants note that, even if these sections were considered to teach the aforementioned limitation, the abovementioned sections of Deshayes fail to disclose mirroring data from a first storage area to a second storage area while the second storage area is in a first state (in which updates to the first storage area are made to the second storage area).

In brief, the cited sections of Deshayes relate to backing up data to and restoring data from a backup medium, and do not relate to mirroring of data and restoring data from a mirror. This distinction is significant.

Backup operations are performed much less frequently than the mirroring of data. In this respect, a mirroring operation provides real time duplication to a mirror of data written to a source (specification, page 2, lines 6-7). Thus, as data is written to the source, it is immediately (or almost immediately) written to the mirror. Thus, mirroring operations occur while the data source is available to receive additional writes.

Conversely, backup operations are performed far less frequently than mirroring operations (e.g., daily, weekly, etc.), and are not real time operations. The data source typically is unavailable for receiving additional writes while it is being back up. For example, Deshayes describes a backup operation that is performed when the source data set is static and taken off-line so that it cannot receive updates during the back up operation (col. 11, lines 32-34).

When data is restored from a back up medium, the medium obviously is not in a mirroring state wherein writes to the source volume are made to the back up medium. In fact, no such relationship ever exists for a backup medium (even during the backup operation). Thus, the fact that the backup medium has no such mirroring relationship during the restore operation is

not remarkable. Backup operations of Deshayes are simply not relevant to the aspects of the present invention directed to restoring data from a mirror.

As discussed above, embodiments of the present invention are directed to mirroring data and restoring data from a mirror (specification, page 1, line 5). In conventional mirroring systems, a restore operation that restores data to the standard storage area from the mirror typically involves not only copying information from the mirror to the standard storage area, but also a resynchronization so that any updates to the standard storage area are passed to the mirror (page 8, lines 6-9). In accordance with one embodiment of the invention, while a restore operation is performed from a mirror to a standard storage area, updates to the standard storage area are not passed to the mirror, so that the integrity of the mirror is retained (page 8, lines 13-15).

The prior art of record simply does not teach or suggest any mirroring system wherein a restore operation is performed from a mirror (as opposed to a backup medium as in Deshayes) while maintaining the mirror in a state wherein updates to a source area are not made to the mirror.

Turning to the sections of Deshayes relied upon by the Office Action, the section at col. 5, lines 49-61 relates to a method of backing up and restoring data. The method includes creating a physical backup of the segment of storage onto the backup storage device, followed by logically restoring one of the logical elements stored in the segment of storage. This section is completely silent as to performing any type of mirroring or real time update between a segment of storage and the backup storage, since the section at col. 5, lines 49-61 relates to a backup storage system, rather than a mirrored storage system.

The section at col. 13, lines 34-58 relates to a scenario where a backup storage system and a client use different operating systems. The section teaches that data may be backed up through a physical backup process, and the restore process may be required to restore data at the physical level. Therefore, this section also relates to backup systems and is completely silent as to a mirrored storage system wherein and restoring data from a mirror.

Although Deshayes discusses mirroring at col. 11, lines 48-64, it does so in the context of teaching techniques for backing up a mirrored system, specifically, if an off-line backup is being performed on a mirrored system, then the mirroring is broken (col. 11, lines 48-50). Breaking

the mirrors severs the normal mirroring procedures (i.e., breaks the mirror links) in the storage system for at least one of the copies of the mirror (col. 11, lines 50-56). The application is then brought on-line, and is permitted to continue processing using a primary copy of the volumes, while the backup is performed using a mirror copy that has been taken out of the mirror redundancy group (col. 11, line 66 – col. 12, line 4). After the backup is performed, the mirrored volumes can be brought back into the mirror redundancy group, by resynchronizing the mirror volumes that were taken off-line and restoring the mirror connection (col. 12, lines 5-10). Once the mirror connection is restored, the mirrors are once more in a linked state wherein any update to one mirror causes an update to each other mirror in the group (col. 3, lines 63-65). Deshayes simply does not teach or suggest restoring data from a mirror.

Furthermore, the Office Action does not specify what elements of Deshayes are believed to meet the first and second storage areas of claim 1, or the first and second states of claim 1. If one attempts to view the primary copy of the mirrors as the claimed first storage area, and any one of the other mirrors as the second storage area, then Deshayes fails to disclose restoring data to the first storage area from the second storage area while maintaining the second storage area in the second state. Deshayes simply does not teach or suggest restoring data to the primary mirror (i.e., the first storage area) from any of the other mirrors (i.e., the second storage area).

Deshayes simply does not teach or suggest mirroring data from a first storage area to a second storage area while the second storage area is in a first state (in which updates to the first storage area are made to the second storage area), and restoring data to the first storage area from the second storage area while the second storage area is in a second state (in which updates to the first storage area are not made to the second storage area).

As should be appreciated from the foregoing, claim 1 patentably distinguishes over Deshayes, such that the rejection of claim 1 under 35 U.S.C. §102 as being anticipated by Deshayes should be withdrawn.

Claims 2-13 depend from claim 1 and are patentable for at least the same reasons.

Claims 14-23

Claim 14 recites a storage system that comprises a first storage area, a second storage area and at least one controller. The controller (1) places the second storage area in a first state

wherein updates to the first storage area are made to the second storage area, (2) mirrors data from the first storage area to the second storage area while the second storage area is in the first state, (3) changes a state of the second storage area from the first state to a second state in which updates to the first storage area are not made to the second storage area, and (4) restores data to the first storage area from the second storage area while maintaining the second storage area in the second state.

As should be appreciated from the foregoing, Deshayes does not teach or suggest at least one controller that mirrors data from a first storage area to a second storage area while the second storage area is in a first state in which updates to the first storage area are made to the second storage area, and restores data to the first storage area from the second storage area while maintaining the second storage area in a second state in which updates to the first storage area are not made to the second storage area as recited in claim 14. Therefore, it is respectfully asserted that claim 14 patentably distinguishes over Deshayes, such that the rejection of claim 14 under §102 as purportedly being anticipated by Deshayes should be withdrawn.

Claims 15-23 depend from claim 14 and are patentable for at least the same reasons.

Claims 24-36

Claim 24 is directed to a computer readable medium encoded with a computer program that, when executed, performs a method similar to that recited above in connection with claim 1. Therefore, for reasons similar to those presented above, it is respectfully asserted that claim 24 patentably distinguishes over Deshayes, such that the rejection of claim 24 under §102 as purportedly being anticipated by Deshayes should be withdrawn.


Claims 25-36 depend from claim 14 and are patentable for at least the same reasons.

CONCLUSION

In view of the foregoing amendments and remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this amendment, that the application is not in condition for allowance, she is requested to call the Applicants' attorney at the telephone number listed below to discuss any outstanding issues relating to the allowability of the application.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 23/2825.

Respectfully submitted,
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